the [French] telegraphic scale [i. e., 4 to 6 m/sec., or about 12 miles an hour].

Mixture with layers of warmer air upon emerging from the wood, rapidly decreases this difference.

It may be asked here, whether this fall in temperature has any influence on atmospheric precipitation. On August 2, with a wind WSW., the west side of the wood was quite immune, but the whole east side was watered by a fine rain that extended almost 2 kilometers out from the eastern margin. At Vievigne, about 1 kilometer distant, the raingage collected 1.4 millimeters of rain. I must admit that this is the only observation that was checked up, although the rainy summer [of 1913] did not lack in other opportunities. However, on several occasions when noticing the road that traverses this little grove from east to west, I have observed that all that portion stretching in front of the wood (east) was moistened, while behind the wood (west) there was no trace of rain.

COMMENT.

The above note by M. Lalin formulates an interesting problem to the forester-meteorologist. The effort to solve the problem experimentally may have been as successful as is stated; but the author does not tell us anything about a most important detail, viz, the conditions under which he exposed his thermometers. As is well known, and was recently emphasized again (this REVIEW, August, 1915, pp. 389–390), the usual French screen does not permit us to compare temperatures within such narrow limits as 0.3 or 0.5 degree centigrade difference in readings. The American meteorologist will therefore reserve judgment on both the temperature influence and the rainfall believed to have been produced by this restricted wood.—C. A., jr.

ORGANIZATION OF THE METEOROLOGICAL OFFICE IN LONDON.[1]

By W. N. SHAW, Director.

[Dated: London, S. W., Dec. 22, 1914.]

His excellency asked to be informed of the "*textes législatifs et administratifs* qui réglementent les services de météorologie générale et plus particulièrement de météorologie agricole en Grande Bretagne."

Textes législatifs.—The only legislative authority for the meteorological services of this country in any year is the appropriation by Parliament of a sum as a "Grant-in-Aid" for the "Meteorological Office" in the appropriation act of that year.

A "Grant-in-aid" is a fixed sum handed over by His Majesty's Treasury to be administered under conditions laid down by the Treasury, by some body of persons, whether constituted expressly for that purpose or not, who become responsible for the expenditure and for any administrative action taken in conformity with the prescribed conditions.

The Ministers responsible to Parliament for the grant, the Lords of the Treasury, accept no responsibility for the actions of the administrative body provided they are within the prescribed conditions.

The grant for the expenses of the Meteorological Office was fixed at £20,000 [$97,330] in the year 1913. It is included in the Votes for Scientific Investigations, and is made to the Meteorological Committee, a body constituted by a Minute of the Treasury.

By custom, the committee which administers a grant-in-aid is allowed to undertake the administration of other grants, and also to receive payment for special duties undertaken for, or in certain cases, to departments of Government. It is not entitled to the official services of the Post Office or other departments of state, but by special arrangement the Meteorological Office enjoys certain official facilities with regard to the priority of meteorological telegrams and with regard to stationery and printing.

The total expenditure on the various services in the administration of the Meteorological Committee is about £30,000 [$145,995] a year. It must, however, be pointed out that the meteorological observations available at the office include those which are carried on by municipal corporations and by private persons primarily for their own purposes and at their own expense. The office acts only as adviser, organizer, compiler, and publisher of results in these cases. This voluntary work—taking observations of rainfall also into account—probably represents an expenditure of £20,000 [$97,330], making the whole expenditure on meteorological services in [Great Britain and Ireland], including municipal and private enterprise, about £50,000 [$243,325], of which £21,000 [$102,196] is provided by Government.

Textes administratifs.—The only *textes administratifs* for the meteorological services are the Minute of the Lords Commissioners of His Majesty's Treasury, dated 20th May, 1905, constituting a Director of the Meteorological Office and a Meteorological Committee with the Director as chairman, and subsequent Treasury Minutes reconstituting the committee or appointing members thereof.
* * *

In accordance with regulation, accounts of the receipts and expenditure of the office for each year are audited by the Comptroller and Auditor General and reported to Parliament. A report upon the work of the office is presented each year to the Treasury and laid before Parliament by command of His Majesty.

Any member of Parliament is therefore at liberty to raise any question upon the accounts or the report, but otherwise, with the limitations herein indicated, the director and committee have full discretion as to the objects to which the funds shall be devoted and the means which shall be adopted for securing them.

The practice of the Office is guided by tradition which has been formed in the past 60 years. The grant-in-aid has been increased from time to time for reasons urged either by the controlling authority or by parliamentary critics of the Office. Each increase has carried with it the intention to accomplish some specific object, and therefore, a tacit obligation on the part of the controlling authority; but the Treasury has never made conditions about details of expenditure and has always accepted the statement of the proposed allocation of the grant without comment, so that the Committee is not bound by any conditions but merely guided by its own judgment in accordance with tradition and practice.

It is important to note this in consideration of the special application of meteorology to agriculture. That is one of the objects of the Office, but any other of the applications of meteorology in the interest of the public is equally so. There is no special allocation of funds for the application of meteorology to agriculture as such.

[1] *Reprinted from* Tenth Annual Report of the Meteorological Committee * * * for the year ended 31 March, 1915 (the 60th year of the Meteorological Office). London. 1915, pp. 65–74.
This memorandum was "drawn up * * * at the request of the Foreign Office, dated 2d February, 1914, for the use of the French Ambassador [to Great Britain]".

GUIDING PRINCIPLES OF THE METEOROLOGICAL OFFICE.

The operations of the Meteorological Office being guided so largely by tradition and practice, without any *textes administratifs* which prescribe its duties and operations in detail, the only means of obtaining a conspectus of the guiding principles of its organization is by reference to the annual reports which have been issued since 1868, to occasional reports before that date and to the reports of certain Committees of Inquiry, from which the present organization has grown. It now comprises a central office with 4 technical divisions, 2 branch offices, 6 meteorological observatories, about 30 subsidized stations and upward of 300 voluntary stations. Terrestrial magnetism and seismology are associated with meteorology. The reports are, however, so voluminous that the following brief historical retrospect may be acceptable. It is necessary to go into some detail because the subject ultimately under consideration is the application of meteorology to agriculture, and in such a case application means that the agriculturist must be in a position to receive and use the information which the meteorologist has to give. This requires much preliminary work, first, to put the meteorologist in possession of the necessary facts and principles, and secondly, to enable the agriculturist to understand the technical language and ideas without which communication is meaningless.

Marine meteorology.

1. The Meteorological Office was started in 1854 under Admiral R. FitzRoy as the meteorological department of the Board of Trade, and on the recommendation of an International Maritime Conference held at Brussels in 1853. The sole purpose of the department was the supply of meteorological instruments to the navy and mercantile marine, and the collection and discussion of meteorological observations from ships.

Those duties still remain in much the same form. They are undertaken partly by the instruments division and partly by the marine division of the office.

Daily weather study—Telegraphic reporting and anemograph stations.

2. Moved specially by the loss of the *Royal Charter*, in 1860 Admiral FitzRoy in cooperation with Le Verrier and with the support of the Prince Consort, began daily telegraphic reports from stations in this country and subsequently from France. With the aid of charts prepared from the observations, he commenced the issue of "forecasts" and "storm warnings." This was the very beginning of what is now the forecast division of the Office. The procedure was sharply criticized by the scientific authorities of the time, and upon FitzRoy's untimely death in 1865 the Board of Trade took the matter up with the Royal Society. Upon the report of an interdepartmental committee (Board of Trade and Admiralty) a new departure was taken.

Observatories of the first order.

3. In 1867 a grant-in-aid of £10,000 [$48,665] was assigned to a Meteorological Committee (unpaid) to be appointed by the Royal Society and having the following enlarged duties, viz:

(*a*) To continue the work in maritime meteorology of the meteorological department of the Board of Trade.

(*b*) To continue the study of weather by means of daily telegraphic reports, but not to issue forecasts or storm warnings. (The storm warnings were replaced [i. e., resumed] by request of the board of trade, but the forecasts remained in abeyance till 1879.)

(*c*) To bring to the assistance of the study of weather, the records obtained from self-recording instruments at seven special land observatories established for the purpose. (This marks the introduction of observatories into the Meteorological Office system. There are now 5 meteorological observatories, two of which include magnetism and seismology, and a central observatory for the study of the upper air.)

Climatology and the meteorology of the globe.

4. In 1872 an International Conference of Meteorologists was held at Leipzig, which was followed by international congresses of duly accredited representatives at Vienna in 1874 and ultimately at Rome in 1879. These international meetings concerned themselves partly with the exchange of information by telegraph between countries in Europe, and also with the study of climate which is primarily of local or national importance, but ultimately has to do with the meteorology of the globe.

Exchange of publications.

These meetings also led to the organization of an elaborate exchange of publications, so that a meteorological office has become the most cosmopolitan of all institutions and is in direct communication with every civilized country.

The international meetings not only increased the importance of the daily weather exchange, but introduced a new subject, climatology, into the work of the Office, which in England and Scotland had been the care of voluntary societies.

Thereupon the Scottish Society, through representatives in Parliament, demanded a subvention and failing that an inquiry into the administration. There was also much dissatisfaction about the marine work, and the inquiry was granted by the Treasury, which appointed a committee of inquiry under the chairmanship of Sir William Sterling Maxwell.

Statistical division—Special researches.

5. Upon the report of that committee in 1877 the Treasury decided to revise the constitution, to place the actual direction as well as the general control of the Office in the hands of a paid Council appointed by the Royal Society with the sanction of the Treasury. The grant became £14,500 ($67,564). Climatological work was added to the obligations of the Office and is now represented by the statistical division, which concerns itself with the publication of the official yearbook. Also by the same instrument "special research," which included experimental work of various kinds, was recognized as a legitimate object of expenditure.

Daily information for newspapers—Evening telegraph service.

6. In 1879 the study of weather with the aid of daily telegrams and of self-recording instruments at observatories was pronounced to be sufficiently far advanced to justify the issue of forecasts, and they were accordingly

issued at 11 a. m. daily to public offices and newspapers gratis, and to "subscribers." But the Times newspaper desired also an evening issue that might be printed in the morning paper. For some time the money necessary for the additional service was provided by the Times and subsequently by a syndicate of newspapers. Then the Government accepted the obligation and increased the grant first by £500 and subsequently by £300 more on that account [$3,893 in all]. The Office was accordingly charged with a new duty—the supply of weather information in the evening to newspapers. It is now associated with evening duty for the Admiralty and military air stations.

7. From 1880 things went on without change for more than 20 years, but in 1903 the Scottish members of Parliament again demanded an inquiry on account of the failure of the Scottish Society to obtain a subvention sufficient to maintain the observatory on Ben Nevis from the grant made to the Meteorological Office. Another inquiry was set on foot by the Treasury, and a committee appointed under the chairmanship of Herbert Maxwell. This committee reported in 1904, and resulted ultimately in the Treasury Minute of May 20, 1905, already referred to.

Réseau mondial—Library.

In the meantime the library had become a most important matter, and the compilation of information about climate and weather in the various parts of the British Empire practically constituted a new department of activity. The pressure on the one hand of the International Meteorological Committee and on the other hand of the study of solar physics, has gradually led to the recognition of an obligation toward a *réseau mondial* as specially incumbent upon the Meteorological Office as the central institution of its kind for the Empire. This has become part of the duty of the secretarial and library division of the Office.

Investigation of the upper air.

Since the Meteorological Committee was constituted, in 1905, many changes have supervened; telegrams from Iceland, wireless telegrams from ocean steamers; the air departments of the navy and the army; the absorption by the Office of the whole duty as regards climatology, previously discharged by the societies with the aid of a subvention. The Office has also become the central institution for the meteorological investigation of the upper air. It has taken over the direct control of observatories which were previously under separate authorities, and this step has brought with it the responsibility of the office for certain aspects of terrestrial magnestism as well as of atmospheric electricity and seismology. These changes have been associated with an increase of the grant to £20,000 [$97,330].

Colonial observations.

The Office has also become an advisory center for those British colonies which have no separate meteorological organization, and it also assists the meteorological institutes of the Dominions in the selection and purchase of instruments.

British Rainfall Organization.

Thus the horizon of work of the Office, which was originally limited to the collection and discussion of observations from the sea, has now become very wide; but it does not yet include all the British meteorological interests. The important subject of rainfall over the British Isles is still the care of a private organization—"The British Rainfall Organization." The Meteorological Office makes no attempt at the detailed representation of rainfall, and only deals with rainfall as part of climatology.

When, therefore, the application of meteorology to agriculture is considered, so far as the Meteorological Office is concerned, anything which is dependent upon the detailed study of the distribution of rainfall is not necessarily included.

In a recent communication to the Treasury the purposes which the Office keeps in view have been defined in the following terms:

I. The collection of observations from ships on all oceans, together with the discussion and publication of meteorological results for the benefit of sailors and as a contribution to the meteorology of the globe.

II. The collection and publication of reports received by telegraph and the issue of forecasts and storm warnings based upon them.

III. The maintenance of observatories and anemograph stations to furnish material for the scientific study of the phenomena of weather as exhibited on the daily charts, and the application of the study to the improvement of forecasting and other purposes.

IV. The organization and maintenance of a trustworthy public memory of the weather, which is available for reference at any time by all classes of the community. This also forms a basis for the study of the climatology of the United Kingdom in comparison with that of other countries, and in its relation to agriculture, public health, and other public purposes; to discuss the observations with a view to the definition of climatic factors for this country in comparison with others; and ultimately to establish the relationships of seasons and more general laws of climate and weather that should lead up to a rational forecast of coming seasons.

V. Cooperation with the British dominions and foreign countries for improving the organization and the instruments by which the purposes enumerated above are to be pursued, and for the effective representation of the meteorology of the globe.

Apart from the question of special researches by individuals at the central office or at the observatories, the means which are adopted by the committee for securing those objects are set out in the Circular 001, together with a copy of the latest report [1914] of the Committee, which gives on pages 6–8 the names of the staff, consisting of about 80 persons.

These facts will enable his excellency to form an opinion as to the rather complicated structure which is represented by the meteorological organization of [Great Britain]. References are given to the original documents which form the material through which the gradual development of the structure can be traced. It consists of a central office, with branch offices, observatories, and stations. The work of the central office is in five divisions, viz:

1. Marine meteorology.
2. Forecasting, storm warnings, and dynamical meteorology.
3. Climatology and statistics.
4. Instruments and equipment for observatories and stations.
5. Library, inquiries, and Réseau mondial.

METEOROLOGY AND AGRICULTURE.

Some addition is necessary with regard to the important and difficult question of *la météorologie agricole*. It is really an open question whether the responsibility for the application of meteorology to agriculture belongs to the Meteorological Office or to the Board of Agriculture and Fisheries in England and the corresponding departments in Scotland and Ireland. The traditional attitude of the Meteorological Office is that it collects and digests meteorological information which the agriculturist can apply

if he wishes, and from that point of view the following publications by the Meteorological Office are regarded as suitable:

FORECASTS.

1. The *Daily Weather Report* with the provisions set out for telegraphing forecasts for a small fee to those who are willing to pay for the telegrams.

Forecasts are prepared throughout the year each morning at 10 a. m. and each evening at 7 p. m., and during the harvest season—June to September—in the afternoon, specially for agriculturists.

STATISTICS.

2. The *Weekly Weather Report*, which was projected specially with a view to agriculture and public health, gives a summary of the pressure, temperature, sunshine, and wind in a form which was designed to be specially suitable for agricultural purposes. This report has now been continued for 36 years and forms a homogeneous body of statistics week by week, which is, for that purpose, probably unrivaled in the world. But it has a very small circulation outside official circles.

3. The *Monthly Weather Report* which gives the usual climatological information for about 300 stations in the British isles.

In actual practice these provisions are very little used by agriculturists. Many persons are willing to receive forecasts by telegraph, but are unwilling to pay for the telegrams; it is entirely contrary to the instinct of the British race to pay for anything until its value has been made undeniably clear, so that the farmer and the Govment are both waiting for the utility of the forecasts to be demonstrated beyond cavil. Yet that can only be done by trial, and nobody has yet been found who is willing to pay the cost of an adequate trial on a large scale. The Meteorological Office could, if the committee wished, undertake that experiment, but it would mean diverting some of its funds from meteorological study to meteorological applications. It is naturally disposed to make quite sure of success before it embarks on a speculation of that kind, and certain success is the reward [only] of careful study. No institution with scientific instincts is disposed to commit itself to the position that its knowledge is complete and that it can forego any further investigation, especially in such a subject as the study of weather.

The climatological aspect of *la météorologie agricole* is a matter of the greatest difficulty. The practical farmer has made his own study of weather and used it in his own way without committing the results to writing. The Meteorological Office commits a vast number of figures to print without knowing what their precise application to agriculture is. All are agreed that agriculture depends upon weather, but to ascertain the manner in which the figures of the meteorologist can be applied to supplement the farmer's practical experience of weather is a matter requiring something that approaches to genius.

The relations between the Meteorological Office and the boards of agriculture in the United Kingdom are of the happiest, but neither side knows exactly how nor where to begin. Some progress has, however, been made in this country. Some years ago the Meteorological Office issued a note about the wheat crop in relation to the rainfall of the previous autumn, and this was taken up by a member of the staff of the Board of Agriculture, who produced a most valuable discussion by modern statistical methods of the relations of weather and crops for one district of England.

EDUCATION.

The further development of the application of meteorology to agriculture is largely dependent upon education in rural schools. The study of weather is now becoming a part of education in many schools, rural as well as urban, so that the prospect of more effective organization is good. The provision for this is shown in Circular E .03.

But thus far as regards organization, at present the formal responsiblity of the Office is limited to preparing forecasts and compiling statistics which will be indispensable when further investigation has so far developed the laws of weather as to allow of forecasting coming seasons.

That is one of the avowed objects of the *réseau mondial*, and the work thereupon must therefore also be regarded as a contribution to *la météorologie agricole*, although the practical farmer would probably not so regard it.

ANSWERS TO INQUIRIES.

Perhaps the most valuable provision of the Meteorological Office at the present stage is the provision for answering inquiries about the weather on the part of the general public. Any public department and any private person may ask any question that can be answered by a knowledge of the facts and laws of weather, and to such questions answers are given with all the intelligence that the Office can command. Many inquiries are answered, and the inquirer often finds the Office to be possessed of information of which he was unaware.

This provision allows inquiry to be directed along the lines which the agriculturist opens; among the subjects which have already been the subject of inquiry may be mentioned—spring frosts, and the protection of vegetation by "smudging"; autumn frosts; the effect of gunfire upon rainfall, particularly during harvest; spells of fine weather for harvest; temperature in relation to sugar growing; the limits of forestation prescribed by temperature; atmospheric humidity in relation to brewing.

By watching the trend of these inquiries, and by the organization of the means of preparing intelligent replies, the Meteorological Office hopes to approach the question of *la météorologie agricole* on lines suggested by agriculturists themselves, and at the same time by encouraging the development of weather study in schools to lead up to the spontaneous use of the information compiled in the Office.

If necessary, the form of the information which meteorologists have hitherto put forward as representing the main features of climatology will be altered so as to meet the needs of the agricultural inquirer.

In fine, it may be said that at present the Meteorological Office is more concerned with the means for organizing *la météorologie agricole* on a satisfactory basis than with any organization actually in operation.

WEATHER BUREAU EXHIBIT AT SAN FRANCISCO, 1915.

By J. CECIL ALTER, Observer in Charge.

[Dated: Denver, Colo., Sept. 7, 1915.]

The allotment of space for the United States Weather Bureau exhibit at the Panama-Pacific International Exposition was made early in July, 1914, and a detailed outline of the exhibits, and the proposed arrangement, prepared, which was approved by the chief of bureau, and by the representative of the Agricultural Department on the Government Exhibit Board.

About 700 visitors to the Weather Bureau exhibit were estimated from partial count the first afternoon, February 20. There being no provision for illuminating the exposition palaces, the exhibits were closed at 6 p. m., and